

# A review of the *Diogenes* (Crustacea, Paguridea) hermit crabs collected by Bedford and Lanchester from Singapore, and from the 'Skeat' Expedition to the Malay Peninsula, with a description of a new species and notes on *Diogenes intermedius* De Man, 1892

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**SYNOPSIS.** Species of the hermit crab genus *Diogenes*, collected by Francis P. Bedford and William F. Lanchester from Singapore, and from the 'Skeat Expedition' to Malay Peninsula near the turn of the century have been reviewed for the first time. Specimens identified as *D. senex* Heller from Lanchester's Singapore collecting trip represent an undescribed species, while those from the 'Skeat' expedition to the Malay Peninsula have proved to represent the taxon recently described as *D. stenops* Morgan and Forest. Similarly, specimens identified by Lanchester as *D. rectimanus* Miers do not represent that taxon, but rather *D. avarus* Heller and *D. goniochirus* Forest. Because of this latter confusion, the holotype of *D. rectimanus* has been redescribed. Lanchester's specimens assigned to *D. planimanus* Henderson include both *D. planimanus* and *D. intermedius* De Man. However, the species name, *D. intermedius* De Man, 1892 is preoccupied and a replacement name is proposed. *Diogenes mixtus* Lanchester also has been redescribed, and *D. desipiens* Lanchester placed in synonymy with *Paguristes hians* Henderson. All of the species have been illustrated.

## INTRODUCTION

In a recent review of specimens assigned to *Diogenes senex* Heller, 1865, by McLaughlin and Haig (1995), Heller's (1865) taxon was restricted, by neotype designation, to a species presently known only from the eastern coast of Australia. Among the other specimens of *D. senex sensu lato* examined by McLaughlin and Haig (1995) were three lots from the Natural History Museum (BMNH): one from East Africa (BMNH 1955.3.5.58–60), one from the Suez Canal (BMNH 1927.11.2.226), and one from Singapore (BMNH 1905.10.21.33–36). These authors did not attempt to identify the

species from East Africa. They noted that the specimen from the Suez Canal agreed with those identified by Bouvier (1892) and Nobili (1906) as *D. senex* from Suez and Djibouti that had subsequently been referred to *D. gardineri* Alcock, 1905 by Lewinsohn (1969). While the specimens from Singapore 'were definitely' not *D. senex sensu stricto*, McLaughlin and Haig were unable to determine their identity. All three lots have now been reexamined. The specimens from the Suez Canal have been compared with specimens of *D. gardineri* from its type locality, the Maldives Islands, and the identity of the Museum specimens as that species has been verified. The specimen from East Africa has also proved to be *D. gardineri*. The specimens from Singapore represent an undescribed species.

There is little information accompanying these latter specimens except the locality, Blakang mati, Singapore, and the collectors, Bedford and Lanchester. However, as mentioned by Lanchester (1900a) and Ingle (1991), Bedford and Lanchester collected in the Straits Settlements (Singapore and Malacca) during a seven month period (1899–1900). Francis P. Bedford was an echinoderm specialist, but collected on that occasion with Lanchester (Ingle, 1991). William F. Lanchester is best known in the British carcinological community for his publications on the Brachyura from Singapore and Malacca, the Crustacea of Malaysia from the collections of the Karawak Museum and those of the 'Skeat' Expedition to Malaysia (Lanchester, 1900a, 1900b, 1901; Ingle, 1991). Lanchester's (1900a) report 'On a collection of crustaceans made at Singapore and Malacca. — Part I. Crustacea Brachyura', suggested that a second part, dealing with the other Crustacea, was planned, but apparently was never published. Although the brachyuran crabs from the Singapore collection were acquired by the Natural History Museum in 1900 (reg. 1900.10.22); these particular hermit crabs were not added to the registry until 1905.

The second part of Lanchester's report on the Crustacea from the 'Skeat' Expedition to Malaysia (Lanchester, 1902) did deal with the Anomura, Cirripedia, and Isopoda, and included the descriptions of two new species of *Diogenes*, i.e., *D. desipiens* Lanchester, 1902 and *D. mixtus* Lanchester, 1902, and one lot each of specimens attributed to *Diogenes senex*, *D. rectimanus* Miers, 1884, and *D. planimanus* Henderson, 1893. McLaughlin and Haig (1995) expressed the belief that Lanchester's (1902) *D. senex* might correctly represent a species of the *Troglopagurus* group of *Diogenes* (cf. Forest, 1952).

All of Lanchester's (1902) *Diogenes* species from the 'Skeat' Expedition in the collections of the University Museum of Zoology, Cambridge (UMZC) were examined during the present study and despite a thorough search, the single male specimen upon which Lanchester based his description of *D. desipiens* could not be located. Correspondence between Lanchester and then Superintendent S.F. Harmer, and a list of Crustacea from the expedition identified by Lanchester appear in volume V of the University Museum's 'History of the Collection'. Only *D. desipiens* is absent from that list, which suggests strongly that it was never registered at the Museum (R. Symonds, pers. comm.). Consequently, searches were made of the collections of the BMNH and those of the National University of Singapore. Both failed to locate Lanchester's specimen, and it must be presumed that it is no longer extant.

As indicated above, the BMNH's Singapore specimens attributed to *D. senex* are described herein as a new species of *Diogenes*. Lanchester's (1902) Malay *D. senex* is, as suspected by McLaughlin and Haig (1995), a species of the *Troglopagurus* group of *Diogenes*, i.e., *Diogenes stenops* Morgan and Forest 1991. Lanchester's (1902) description of *D. mixtus* consisted of little more than a comparison with three other species. It is now redescribed from the type materials and one additional specimen from Malaysia. Both Lanchester's (1902) *D. rectimanus* and *D. planimanus* have been compared with type material of their respective taxa. His *D. rectimanus* is represented by two different taxa, *D. avarus* Heller, 1865, and a species subsequently described by Forest (1956) as *D. goniochirus* Forest; his *D. planimanus* includes specimens of both *D. planimanus* and *D. intermedius* De Man, 1892.

Notwithstanding the length of Miers' (1884) description, neither it nor his figures are particularly diagnostic, which may account for Lanchester's (1902) confusion. Consequently, the holotype of *D. rectimanus*, also in the collection of the BMNH, is redescribed. De Man's (1892) original description of *D. intermedius* was based on the comparison of a single specimen (sex not indicated) from Pare Pare, Celebes (Sudawesi, Indonesia), that seemed to differ from the

presumed type specimens of *D. custos* (Fabricius, 1798) and *D. miles* (Fabricius, 1787), but incorrectly attributed to H. Milne Edwards (1837). De Man (1892) was sufficiently uncertain about the singularity of his specimen that he described it simply as *Diogenes* sp. with the notation that should it prove to be a species distinct from *D. custos* it should be called *D. intermedius*. Although he provided a rather detailed description, it essentially indicated the differences between his specimen and *D. custos*, and was not accompanied by any illustrations. Until now, subsequent reports have not been based on material. The nomenclatural status of the species name *Diogenes intermedius* De Man, 1892, is compromised because it is preoccupied by *Diogenes pugilator* var. *intermedius* Bouvier, 1891. This matter is resolved by proposing a replacement name for De Man's taxon.

Although the type specimen of *D. desipiens* has not been located, Lanchester's (1902) description and illustrations have been carefully examined. It is our opinion that *D. desipiens* is not a species of *Diogenes*, but rather of *Paguristes*, and in fact is a junior subjective synonym of *Paguristes hians* Henderson, 1888. A comparison of Henderson's taxon, based on its holotype and supplemental material, with Lanchester's (1902) account, provides justification for our synonymy.

## MATERIALS AND METHODS

The new species of *Diogenes* comes from the Bedford and Lanchester collection housed in the BMNH. The syntypes of *Diogenes mixtus*, the Malaysian specimens assigned to *D. senex*, and the specimens identified by Lanchester (1902) as *D. rectimanus* and *D. planimanus* have been borrowed from the University of Cambridge collection. The holotype of *Diogenes rectimanus*, the specimen herein designated lectotype of *D. planimanus*, the holotype of *Paguristes hians*, two paralectotypes of *D. goniochirus*, and the additional specimen of *Diogenes mixtus* from Kuching, Malaysia, are in the BMNH collection. The holotype of *D. intermedius* has been borrowed from the Instituut voor Taxonomische Zoölogie (Zoölogisch Museum), Universiteit van Amsterdam (ZMA). Four paratypes of *D. stenops*, borrowed from the Western Australian Museum (WAM), have been compared to verify our determination of Lanchester's (1902) '*D. senex*'. One measurement, shield length (SL), measured from the midpoint of the anterior margin of the shield to the midpoint of the posterior margin provides an indication of specimen size. Photographs all were taken with Nikon 35 mm cameras equipped with a Medical Nikkor 1:5.6/F=200 or Micro Nikkor Auto 1:3.5/F=55 mm lens.

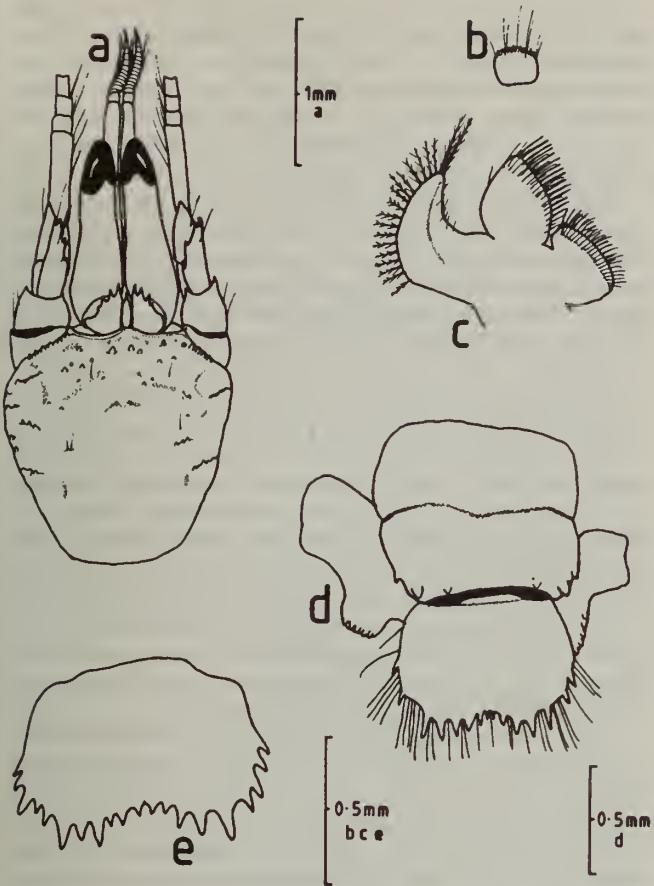
## SYSTEMATIC ACCOUNT

### *Diogenes inglei* sp. nov.

(Figs 1a–e, 2a–d, 10a)

**MATERIAL EXAMINED.** Holotype. Ovigerous ♀ (SL = 1.46 mm), in 'shell' which actually is fragment of worm tube; Blakang mati, Singapore, 1899, collectors, F. Bedford and W. F. Lanchester, BMNH 1905.10.21.33. Paratypes. 2 ♀, 1 ovigerous ♀ (SL = 1.13–1.52 mm), same locality, date and collectors, BMNH 1905.10.21.34–36.

**DIAGNOSIS.** Shield surface (Fig. 1a) anteriorly and laterally

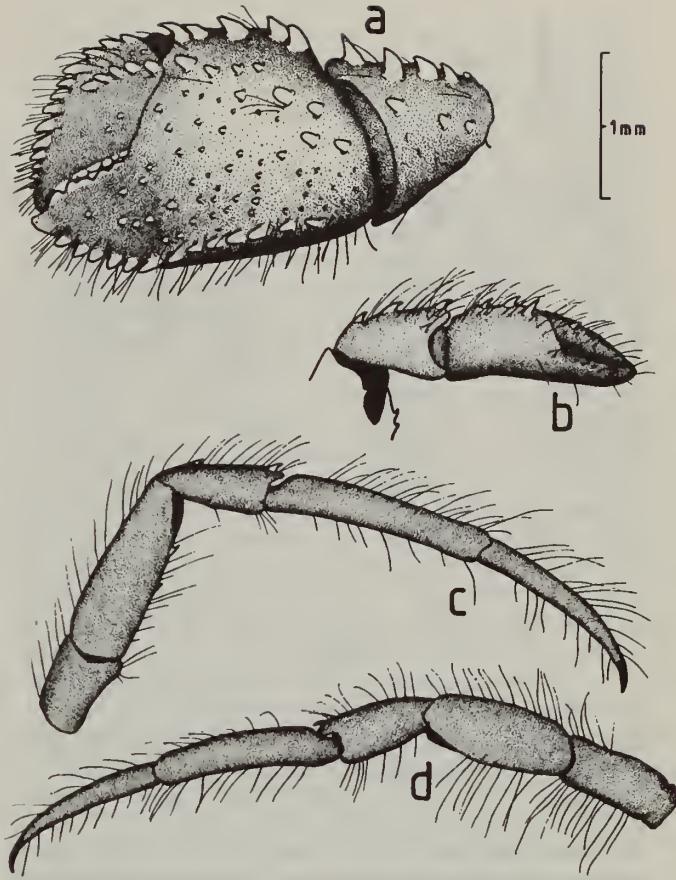


**Fig. 1** *Diogenes inglei* sp. nov., holotype ovigerous ♀ SL = 1.46 mm, BMNH 1905.10.21.33; a. shield and cephalic appendages; b. anterior lobe of sternite of 3rd pereopods; c. 1st maxilliped; d. 6th abdominal tergite, protopods of uropods and telson; e. telson.

weakly spinulose. Dorsal margins of branchiostegites with 3–6 small spines or spinules. Ocular peduncles swollen proximally and narrowing distally to tapering corneae; overreached by antennular peduncles. Ocular acicles with 1–3 strong and 1 or more smaller spines. Intercalary rostriform process slender, reaching beyond proximal half of acicle but not to tip of inner-most acicular spines; no ventral spine. Antennal peduncles reaching to or slightly beyond distal margins of corneae. Antennal acicle simple, with bifid terminal spine and 2 widely-spaced spines on mesial margins. Antennal acicles with pair of long pinnate setae on each article. First maxilliped (Fig. 1c) without exopodal flagellum.

Left cheliped (Figs 2a, 10a) with row of prominent spines on upper margins of dactyl, palm and carpus, and lower margins of palm and fixed finger; outer surface of dactyl with short row of spines near upper margin; palm and fixed finger with scattered small spines or tubercles, irregular row of larger spines near upper margin of palm. Right cheliped (Fig. 2b) with row of 3 spines adjacent to upper margin of palm; 3 strong spines on upper margin of carpus. Carpi of ambulatory legs (Figs 2c, d) each with dorsodistal spine and 1 additional spine on dorsal surface proximally on second pereopods. Tergite of sixth abdominal somite with lateral and terminal spines marginally.

Telson (Figs 1d, e) with median cleft practically obsolete; terminal margin with row of several large and few smaller spines, extending onto lateral margins.



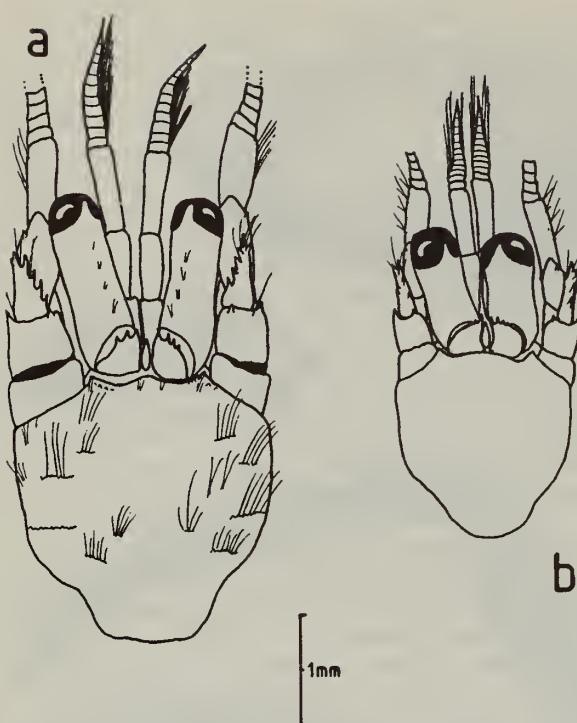
**Fig. 2** *Diogenes inglei* sp. nov., holotype ovigerous ♀ SL = 1.46 mm, BMNH 1905.10.21.33; a. left chela; b. right chela; c. right 2nd pereopod; d. left 3rd pereopod.

**DESCRIPTION.** Shield (Fig. 1a) longer than broad; anterior margin between rostrum and lateral projections weakly concave; anterolateral margins with marginal or submarginal row of small blunt or acute spinules; anterolateral angle unarmed; posterior margin truncate; dorsal surface with scattered spinules anteriorly and laterally. Rostrum obsolete. Lateral projections obtusely triangular, with prominent marginal or submarginal spine. Dorsal margin of branchiostegite with 3–6 sometimes widely-spaced small spines or minute spinules, 1 spine on anterior margin.

Ocular peduncles moderately long, approximately 0.80 length of shield; swollen proximally and narrowing distally to somewhat reduced and distally tapered corneae, dorsomesial surface with row of long fine setae in proximal half. Ocular acicles almost subtriangular, anterior margin with 1–3 strong and 1 or more smaller spines; separated basally by width of intercalary process. Latter moderately well developed, somewhat depressed, reaching beyond proximal half of ocular acicles, with terminal spinule; no ventral spine.

Antennular peduncles, when fully extended, overreaching corneae by approximately 0.33–0.50 length of ultimate segment. Ultimate segment with 1 or 2 long setae on dorsodistal margin. Penultimate segment with few scattered setae. First segment frequently with small spine on ventrodistal margin.

Antennal peduncles reaching to, or slightly overreaching distal margin of corneae; with supernumerary segmentation. Fifth segment with 3 or 4 pairs of long setae on ventral margin distally. Fourth and third segments with few short setae. Second segment with



**Fig. 3** Shield and cephalic appendages, a. *Diogenes goniochirus* Forest, 1956, ♀ SL = 2.15 mm, UMZC Nov. 30, 1899; b. *Diogenes avarus* Heller, 1865, ♂ SL = 1.53 mm, UMZC Nov. 30, 1899.

dorsolateral distal angle weakly produced and terminating in small spine, dorsomesial distal angle with small spine, laterodistal margin usually with 2 small spines, and 1 or 2 prominent slender spines ventrally. First segment with 1 small spine on lateral margin ventrally. Antennal acicle not reaching to distal apex of fourth peduncular segment, terminating in bifid spine, with 2 widely-spaced spines on mesial margin. Antennal flagella moderately short, approximately as long as ambulatory legs; each article with pair of long pinnate (pappose) setae.

Maxillule with endopod lacking external lobe. First maxilliped (Fig. 1c) lacking flagellum; endopod fused to exopod. Third maxilliped with 2 strong spines on basis, ischium without crista dentata but with 1 very strong curved spine; merus with 1 or 2 spines on ventral margin.

Left cheliped (Figs 2a, 3a) with dactyl approximately 0.33 longer than upper margin of palm; cutting edge with row of calcareous teeth; terminating in small calcareous claw, overlapped by fixed finger; outer surface flattened, with short row of 4 or 5 blunt to extremely slender and acute spines near upper margin and 2 or 3 spinules centrally; upper margin with row of strong, subacute to extremely acute spines, decreasing in size distally and sparsely interspersed with long setae; inner surface with few widely scattered long setae. Fixed finger with outer surface flattened, armed with few scattered small blunt or sharp spines; lower margin armed with row of strong, blunt or acute spines, sparsely interspersed with long setae, and forming weak curve with lower, similarly armed margin of palm; cutting edge with row of calcareous teeth; terminating in prominent calcareous claw. Palm with outer surface convex, armed with scattered blunt or acute spines, with irregular row of stronger spines beginning near midpoint of proximal margin, curving upward, and continuing to near distal articulation with fixed finger; upper margin with 5 or 6 strong subacute or very acute curved spines; inner surface with few scattered tufts of short setae. Carpus

approximately equal to or very slightly longer than palm; upper margin with row of 4 or 5 strong spines, outer face convex and with slightly oblique row of 3 widely-spaced spines; inner surface glabrous. Merus triangular; dorsal margin with row of spinules and tufts of setae, 1 much stronger spine at dorsodistal margin; ventromesial with 3 or 4 small spines in proximal half; ventrolateral margin with 3 or 4 spinules in distal half. Ischium unarmed.

Right cheliped (Fig. 2b) appreciably smaller than left. Dactyl approximately equal to length of palm; upper margin not distinctly delimited, outer surface with few spinules partially obscured by long setae; cutting edge with row of fine corneous teeth, terminating in small corneous claw and overlapped by fixed finger. Palm with row of 3 spines and long setae on or adjacent to upper margin, convex outer face with varying amounts of long setae, usually 1 additional small spine distally near upper margin and second small spine near base of fixed finger, lower margin unarmed; fixed finger with row of very fine spinules in midline; cutting edge with row of corneous teeth, terminating in small corneous claw; inner surfaces of dactyl, fixed finger and palm with long setae, most numerous on dactyl and fixed finger. Carpus with long setae and 3 strong spines on upper margin, outer surface convex, with few long setae and 1 prominent spine at mid-distal margin; inner and lower surfaces with scattered setae. Merus triangular; dorsal margin with 1 or 2 spinules and long setae, 1 more prominent spine at dorsodistal margin; ventromesial margin with 2 or 3 small spines in distal half, ventrolateral margin with 1–3 spinules distally. Ischium unarmed.

Ambulatory legs (Figs 2c, d) with dactyls approximately equaling length of propodi, both dactyls and propodi of second appreciably longer than third, unarmed but with numerous long setae. Carpi with dorsodistal spine and 1 spine on dorsal surface in proximal half (second), unarmed or with tiny proximal spinule (third), dorsal and ventral surfaces with long setae. Meri with long setae on dorsal and ventral surfaces, second with 2 widely-spaced spines, third unarmed. Ischia unarmed, but with long dorsal and ventral setae. Sternite of third pereopods with subquadrate to subrectangular anterior lobe (Fig. 1b), terminal margin with 3–8 small spines and long setae.

Male pleopods unknown. Female with pleopods 2–4 well developed, biramous; pleopod 5 appreciably reduced, with rudimentary exopod. Tergite of sixth abdominal somite with deep transverse median furrow; posterolateral margins each with 2 spines, terminal margin with 1 spine one each side of midline. Protopods of uropods (Fig. 1d) each with row of small tubercles. Telson (Figs 1d, e) with median cleft obsolete or only faintly indicated; terminal margin slightly concave, with row of several large and few smaller spines, extending onto lateral margins.

#### COLOUR. Unknown.

DISTRIBUTION. At present recognized only from Singapore.

ETYMOLOGY. It is with great pleasure that we dedicate this species to Ray Ingle, formerly of the Crustacea Section, the Natural History Museum, in recognition of his many contributions to our knowledge of decapod crustaceans in general, and of the Paguridea of the northeastern Atlantic and Mediterranean regions in particular.

AFFINITIES. *Diogenes inglei* sp. nov. most closely resembles *D. gardineri* in the general shapes of the left and right chelipeds, and in the armature of the pereopods. *Diogenes inglei* sp. nov. is readily distinguished from Alcock's species by its longer antennal peduncles and flagellum which carries a pair of long pinnate setae ventrally on each article. Differences are also apparent in the armature of the chelipeds. However, variation in cheliped armature is common in species of this genus, and our present knowledge of *D. inglei* sp. nov. is too limited to permit evaluation.

**REMARKS.** The first maxilliped of *Diogenes* species is not often described or illustrated, but in those few species for which it has been (e.g., Tirmizi and Siddiqui, 1982a), a two-segmented exopodal flagellum is typical. *Diogenes inglei* sp. nov. is the only species of the genus currently known to lack the flagellum; in its place are a pair of short setae (Fig. 1c). Whether this loss is unique to *D. inglei* sp. nov. or simply reflects inadequate examinations of other species remains to be determined. It should be noted, however, that the only hermit crabs routinely lacking a flagellate first maxilliped are parapagurids or coenobitids. *Diogenes inglei* sp. nov. also appears distinctive in having the sixth abdominal segment armed with spines on the posterolateral and posterior margins. This again may simply reflect inadequate observations of other species.

### *Diogenes rectimanus* Miers, 1884

(Fig. 10b)

*Diogenes rectimanus* Miers, 1884:262, pl. 27, fig. c; Gordan, 1956:318 (in part; lit.).

? *Diogenes rectimanus*: Henderson, 1893:419; Alcock, 1905b:71, pl. 6, figs 8, 8a, pl. 7, fig. 2, 2a; Ajmal Khan and Natarajan, 1984:20, fig. 17; Morgan, 1987b:175; Haig and Ball, 1988:167; Rahayu and Forest, 1995:395.

Non *Diogenes rectimanus*: Lanchester, 1902:366.

**MATERIAL EXAMINED.** Holotype♂ (SL = 4.30 mm), Prince of Wales Channel, Torres Strait; BMNH 1882.7.

**REDESCRIPTION.** Shield slightly longer than broad, almost subquadrate; anterior margin between rostrum and lateral projections slightly concave, with 5 or 6 small tuberculate spinules near bases of lateral projections; anterolateral margins sloping; posterior margin truncate; dorsal surface with few transverse spinulose ridges laterally. Rostrum broadly rounded; lateral projections each with rather strong marginal spine. branchiostegial margins each with 5 or 6 moderately well developed spines.

Ocular peduncles approximately 0.80 length of shield, moderately stout; cornea not dilated; ocular acicles with straight inner margins, broadly rounded anterolaterally, with 3 small, but prominent spines and several additional smaller spinules, not extending entire length of terminal margin. Intercalary rostriform process reaching approximately to distal third of ocular acicles, broad basally, tapering to moderately slender subacute tip.

Antennular peduncles overreaching cornea by almost entire length of ultimate segment. Ultimate segment with few setae dorsally and tuft distally on both ultimate and penultimate segments; basal segment unarmed.

Antennal peduncles overreaching distal margin of cornea by 0.20–0.35 length of ultimate segment. Fifth segment with row of tufts of setae on ventral margin; fourth segment with few scattered setae and small spine on dorsolateral distal margin; third segment with tuft of setae; second segment with small spine at dorsolateral distal angle and very small spine on dorsomesial distal angle, ventrolateral distal angle with small spinule; first segment with row of small spinules on distal margin laterally and similar row of small spinules on lateral margin ventrally. Antennal acicle not reaching to apex of fourth segment, with strong bifid spine and 4 accessory strong spines on mesial margin, few tufts of setae on lateral margin.

Maxillule without external endopodal lobe.

Dactyl of left cheliped (Fig. 3b) approximately 0.35 longer than palm; double row of spines on upper margin, outermost strongest, row of equally strong spines adjacent to upper margin, outer surface with scattered small spinose tubercles and very short setae; cutting edge with multiple series of small calcareous teeth, largest in distal

third; inner surface with row of low protuberances. Palm slightly shorter than carpus; upper surface with irregular triple row of spines, outer surface with slightly concave area just below upper margin with few scattered spinules and tubercles and tufts of short setae, upper outer face with adjacent longitudinal row of moderately strong spines in proximal half, not reaching articulation of palm, remaining outer surface with rather widely-spaced small spines; proximal margin with row of stronger spines continuing to lower margin, lower outer surface of palm spinose, to with short setae; inner surface with few very small tubercles in lower half; lower margin with row of strong, outwardly directed spines, decreasing in size on fixed finger, and adjacent second row of much smaller spines; surface of fixed finger with spinulose tubercles. Carpus with row of moderately blunt spines on upper margin (distal 2 or 3 stronger), outer surface convex, with series of small tuberculate spines, lower margin with strong spine at lower distal angle, inner and lower surfaces with few tubercles. Merus triangular; dorsal surface rounded, with transverse rows of small spines or spinules continuing onto lateral surface dorsally, one such row adjacent to laterodistal margin appreciably longer, mesiodistal margin with row of tuberculate spines, mesial face tuberculate in ventral half, ventromesial margin with row of broad, low bifid spines, ventrolateral margin with row of spines distally becoming spinulose tubercles proximally, ventral surface with numerous low bifid spinules. Ischium with row of small tubercles on laterodistal margin ventrally and proximal margin.

Right cheliped with dactyl approximately 0.35 longer than palm; upper surface with double row of small spines, outer surface with row of slightly larger spines, both surfaces generally concealed by long setae; cutting edge with row of calcareous teeth, terminating in calcareous claw, slightly overlapped by fixed finger. Palm approximately 0.65 length of carpus; upper surface somewhat spinulose, small spines or spinules forming quasi transverse rows; outer face with few small spines or low protuberances and tufts of setae; fixed finger with 2 rows of moderately strong spines on outer surface, cutting edge with quite prominent calcareous teeth; inner surface of palm with tufts of setae, row of widely-spaced tubercles on fixed finger. Carpus with row of spines on upper margin and second adjacent row on upper outer face, outer distal margin with 2 spines, low protuberances on lower outer face, surfaces all with long setae. Merus with short transverse spinulose ridges and tufts of setae on dorsal margin, lateral face with low spinulose protuberances; ventrolateral margin with 2 acute spines distally, low sometimes bifid spinulose protuberances proximally extending onto ventral surface; mesial face generally glabrous, ventromesial margin with row of small spinules distally, double row of stronger spinules proximally. Ischium with 2 spinules on ventromesial margin.

Ambulatory legs similar. Dactyls 0.25–0.35 longer than propodi; dorsal margins of dactyls each with almost double row of long stiff dense setae, lateral faces with faint transverse sulcus in proximal half and row of long setae, ventral margins each with row of long setae proceeding onto lateroventral margin distally, mesial faces also with row of long stiff dense setae ventrally and second row of stiff setae beginning in upper half and progressing ventrally toward claw. Propodi approximately 0.25 longer than carpi, right with dorsal, ventral, mesial and lateral tufts of setae, left with tufts of setae accompanied by row of spinules dorsal surfaces, strongest on third. Carpi each with row of acute spines, somewhat shorter on third. Meri with dorsal and ventral tufts of setae; second with spinulose protuberances ventrally on lateral faces and row of small spinules on ventral margin, ventrolateral distal margin also with row of spinules. Ischia with 2 or 3 spinules (second) or unarmed (third). Sternite of third pereopods with indistinctly bilobed anterior lobe, each pseudo-lobe with tuft of setae.

Telson with small median cleft, terminal margins of both lobes with long spines interspersed with slightly smaller spines, extending down lateral margin of left only.

COLOUR. Not known.

DISTRIBUTION. Known with certainty only from the Torres Strait, Arafura Sea; ? Persian Gulf, Gulf of Aden, India, Sri Lanka, Indonesia, and Northern Australia.

REMARKS. Henderson's (1893) very brief diagnosis of *D. rectimanus* could refer to several species. The fact that he noted that the lower margin of the left chela and fixed finger was straight, and the fingers very short suggests that he may not have been dealing with Miers' (1884) species. Alcock (1905) stated in his diagnosis that the merus of the left cheliped was not spinose. The merus of the left cheliped of the holotype of *D. rectimanus* has a spinulose dorsal margin; both the ventromesial and ventrolateral margins are spinose. However, Alcock's (1905, pl. 6, fig. 8, pl. 7, fig. 2) figures show a very strongly armed merus, and in other respects do bear considerable similarity to the holotype of *D. rectimanus*. None of the other citations of this species are sufficiently detailed to ascertain whether or not the authors were actually dealing with Miers' (1884) taxon. However, as pointed out by Rahayu and Forest (1995), Haig and Ball's (1988) notation on the reduced armature of the lower margin of the palm of the left cheliped, does suggest that they may not have been, despite the close proximity of their specimen to the type locality.

#### *Diogenes goniochirus* Forest, 1956

(Figs 3a, 8a, 9a, 11a)

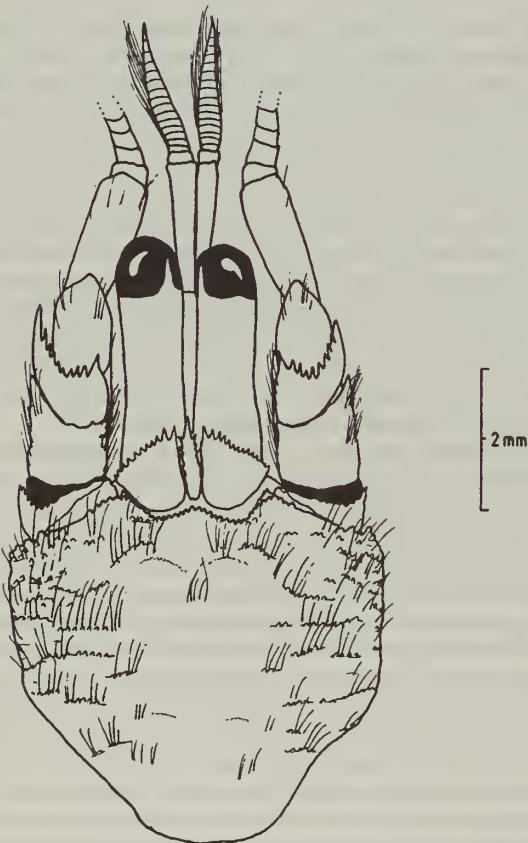


Fig. 4 Shield and cephalic appendages, *Diogenes planimanus* Henderson, 1893, ♀ SL = 4.85 mm, UMZC Nov. 30, 1899.

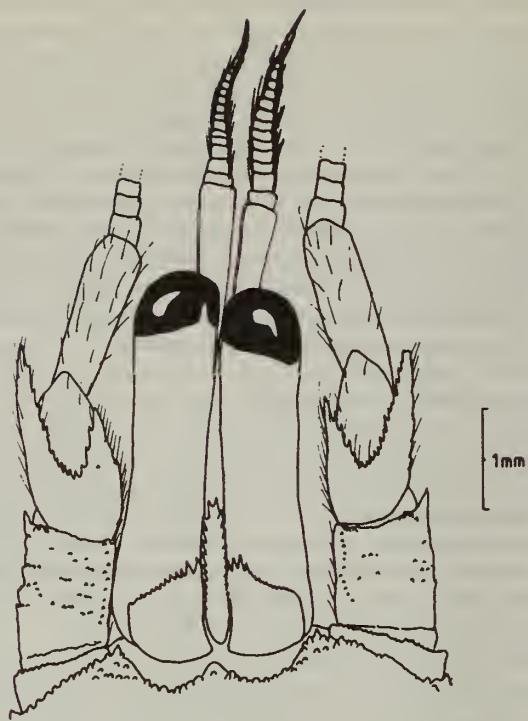


Fig. 5 Anterior portion of shield and cephalic appendages, *Diogenes platvoeti* nom. nov., holotype ♂ SL = 4.81 mm ZMA De201.872.

*Diogenes rectimanus*: Lanchester, 1902:366 (in part) [Non *Diogenes rectimanus* Miers, 1884].

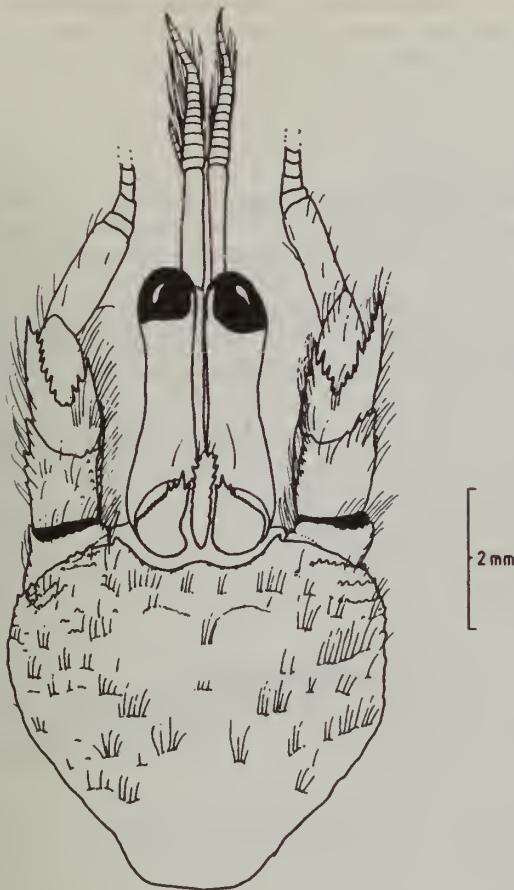
*Diogenes goniochirus* Forest, 1956:527, figs 5–7; Rahayu and Forest, 1995:395.

MATERIAL EXAMINED. Type material. Paralectotype ♂ (SL = 2.78 mm), ovigerous ♀ (SL = 3.05 mm), Long Hai, Cochinchine, Vietnam, Modest, 1905; BMNH 1995.1663–64.

Lanchester material examined. 1 ♀ (SL = 2.15 mm), 'Loc. —', 'Skeat' Expedition, Malay Peninsula; UMZC, Nov. 30, 1899.

DIAGNOSIS. Shield (Fig. 3a) as broad or slightly broader than long; anterior margin with only few spinules between broadly rounded rostrum and slightly produced lateral projections; dorsal surface with few transverse, setose and/or spinulose ridges laterally. Dorsal margin of branchiostegite with row of closely-spaced small spines over entire length. Ocular peduncles 0.75–0.80 length of shield; corneae dilated little if at all. Ocular acicles broadly sub-triangular; terminal margins with 3 or 4 spines, extending approximately half length of margins. Intercalary rostriform process subovate, acute, not reaching to tips of acicular spines, no ventral spine. Antennular and antennal peduncles approximately equal in length, both over-reaching ocular peduncles. Antennal acicles not forked, with simple terminal spine, lateral margin with 1 spine distally, mesial margin with row of 4–6 spines. Antennal flagella with long ventral setae.

Left cheliped (Fig. 11a) with ventral and lateral faces of merus spinulose, ventromesial distal margin with row of very small spines; outer face of carpus spinulose, with longitudinal row of small spines centrally, culminating in strong spinose protuberance distally, upper margin with row of spines; lower surface and margin of palm and fixed finger straight or convex, armed with 3 to several rows of blunt or spinulose tubercles, outer surface of palm spinulose but without median crest, row of small spines on upper margin of palm, sometimes more prominent distally, double row of spines on dactyl. Right



**Fig. 6** Shield and cephalic appendages, *Diogenes platvoeti* nom. nov., ♀ SL = 4.67 mm, UMZC Nov. 30, 1899.

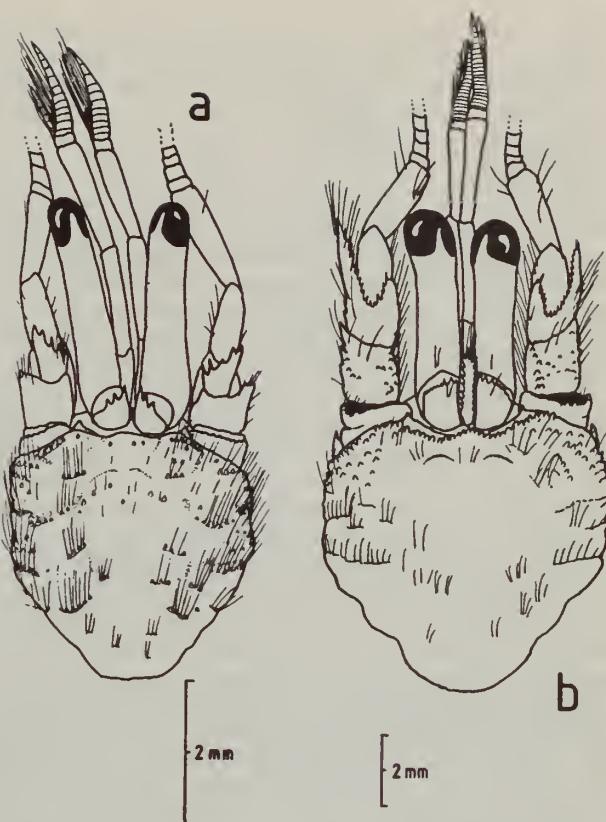
cheliped with row of very small spines on upper surfaces of carpus, palm, and dactyl, all practically obscured by rows of long setae. Ambulatory legs with dorsal margins of carpi each with row of closely-spaced small spines; dorsal margins of propodi each with row of very small spinules and long setae (second) or double row of long stiff setae (third); mesial faces of dactyls (Fig. 8a) each with 4 rows of setae, dorsal and ventral rows long and simple, median rows shorter and pinnate, more distinct on third.

Telson with distinct median cleft, lobes slightly asymmetrical; terminal margins with 2–4 moderate to strong and 3–6 smaller spines, sometimes extending onto lateral margins.

COLOUR. Not reported.

DISTRIBUTION. Vietnam; Malaysia; Indonesia.

REMARKS. The Malay specimen of *D. goniochirus* is the largest of 12 specimens identified by Lanchester (1902) as *Diogenes rectimanus*, and the only one he removed from its shell. Lanchester remarked that the small size of the specimens probably accounted for the lack of prominence of the spines on the lower margin of the left chela and more obscure arrangement of granules on this appendage. Judging from the development of the pleopods, this specimen is most probably a mature female. In having a prominent spinose protuberance on the carpus and lack of a crest on the outer surface of the palm of the left cheliped, this specimen agrees well with the paralectotypes of *D. goniochirus* that we examined. The spinose dorsodistal angle of the palm is also apparent, but not as prominent



**Fig. 7** Shield and cephalic appendages, a. *Diogenes stenops* Morgan and Forest, 1991, ovigerous ♀ SL = 3.11 mm, UMZC Nov. 30, 1899; b. *Diogenes mixtus* Lanchester, 1902, lectotype ♂ SL = 6.88 mm, UMZC 1.10050.

as in the paralectotype female. The setation of the mesial faces of the ambulatory legs is a little more distinct, but corresponds well with that of the paralectotypes. The remaining 11 specimens, all of appreciably smaller size but none the less mature, differ markedly from this specimen of *D. goniochirus*, and are assigned to *D. avarus*.

#### *Diogenes avarus* Heller, 1865

(Figs 3b, 8b, 9b, c, d, 11b)

*Diogenes avarus* Heller, 1865:83, pl. 2, fig. 2; Alcock, 1905:68, pl. 6, figs 6, 6a; Forest, 1956:524, figs 1–4; Lewinsohn, 1969:37, fig. 4; Tirmizi and Siddiqui, 1982a:54, fig. 29; Haig and Ball, 1988:167; Rahayu and Forest, 1995:398, Figs 2b, g, h.

*Diogenes rectimanus*: Lanchester, 1902:366 (in part) [Non *Diogenes rectimanus* Miers, 1884].

? *Diogenes avarus*: Ajmal Khan and Natarajan, 1984:18, fig. 15.

MATERIAL EXAMINED. Lanchester's material. 7♂, 3♀, 1 ovigerous ♀, (SL = 1.04–1.52 mm). 'Loc. ——?', 'Skeat' Expedition, Malay Peninsula, UMZC, Nov. 30, 1899.

DIAGNOSIS. Shield (Fig. 3b) longer than broad, with few short transverse spinulose ridges and long setae on dorsal surface; rostrum obsolete or broadly rounded. Dorsal margins of branchiostegites with 5–8 small spines. Ocular peduncles short and moderately stout; overreached by both antennular and antennal peduncles. Ocular acicles broad, with 1–3 strong spines and several minute spinules on terminal margin, not extending entire length. Intercalary rostriform process slender, reaching beyond proximal half of acicle but not beyond tip of inner-most acicular spines. Antennal peduncles slightly

shorter to nearly equal length of antennular peduncles. Antennal acicle not reaching to distal apex of fourth peduncular segment, with simple or bifid terminal spine, lateral margins usually 1 or 2 spines distally, mesial margins with 3–7 small spines. Antennal flagellum with paired long setae ventrally.

Left cheliped (Fig. 11b) with 1 or more rows of small simple or bifid spines on dorsal margin of merus, ventromesial distal angle with 3 or 4 prominent spines, ventrolateral margin with 2–5 much smaller spines distally; broad upper surface of carpus with 3 rows of small acute or subacute spines, stronger on slightly produced distal angle, outer face angularly convex with tuberculate or spinose protuberance at median distal margin, surface armed with blunt or spinulose tubercles and small spines; lower margin of fixed finger and palm straight, with irregular rows of small tubercles or subacute spines; palm with convex outer surface armed with moderately to closely-spaced tubercles, subacute or acute spines or spinules, and with crest of stronger tubercles or spines proximally near midpoint of proximal margin but not continued to articulation with dactyl, upper margin with irregular usually double row of small spines, strongest on produced upper distal angle; upper surface of dactyl with 3 rows of spines. Right cheliped with noticeable hiatus between dactyl and fixed finger; upper margins of carpus, palm and dactyl each with 1–3 rows of small spines partially obscured by long plumose setae. Ambulatory legs with dorsal margins of carpi each with double row of small spines on dorsal surface of second, usually only single row of smaller spinules on third; propodi with irregular row of small spines or spinules, always on second, frequently on third; mesial faces of dactyls (Fig. 8b) each with 2 rows of rather widely-spaced moderately short setae. Anterior lobe of sternite of third pereopods (Fig. 9b) with roundly rectangular, with tuft of setae on either side of midline.

Telson (Figs 9c,d) with median cleft; terminal margin of left lobe with 3–6 large spines extending onto lateral margin and several very small spinules medially, right terminal margin with 4–6 small spines.

**COLOUR.** Carapace rather uniform dark brown. Ocular peduncles uniform light brown, or brown with broad, oblique white band medially; cornea golden. Proximal segment of antennular peduncles dark brown; distal segment with brown chromatophores on white. Antennal flagella banded brown and white. Merus and carpus of left cheliped solid light brown, chela white; right cheliped solid light brown. Meri of ambulatory legs white with 2 brown bands; carpi light brown with white band distally; propodi white medially, otherwise dark brown proximally and light brown distally; dactyl dark brown proximally and white distally (after Haig and Ball, 1988).

**DISTRIBUTION.** Indian Ocean, from Red Sea and east coast of Africa to Mergui Archipelago; Malaysia; Vietnam; Philippine Islands; Indonesia; New Guinea; northeast coast of Australia.

**REMARKS.** Lanchester's specimens agree well with Forest's (1956) description and with small specimens of this species from northern Australia, particularly in having spinules on the dorsal surfaces of both the carpi and propodi of the ambulatory legs. This is in contrast to the figures of *D. avarus* given by Rahayu and Forest (1995: Fig. 2 g, h) in which the propodi are unarmed, and the third left pereopod has only a few dorsodistal spines on the carpus. However, we observed a similar lack of propodal armature and reduced carpal spination in specimens from Barunda Beach, Lovina Bali. Rahayu and Forest's illustrated specimen was one of their largest males (SL = 3.5 mm), while our specimens from Bali had SL's of 2.84–2.96 mm. The largest of the Lanchester specimens had a SL of only 1.52 mm. It may be that propodal spination is lost with increased animal

size, as the specimens agree in other morphological characters. The identification of *D. avarus* by Ajmal Khan and Natarajan (1894:18, fig. 15) is uncertain.

### *Diogenes planimanus* Henderson, 1893

(Figs 4a, 9c,e, 12a)

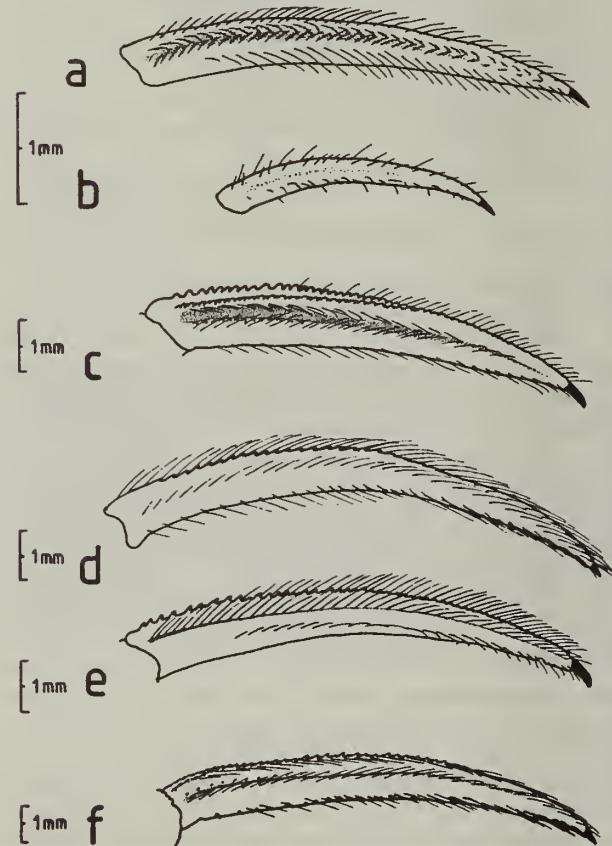
*Diogenes planimanus* Henderson, 1893:416, pl. 39, figs 5, 6; Lanchester, 1902:365 (in part); Nobili, 1903a:15; Dechancé, 1964: 35; Tirmizi and Siddiqui, 1982a:43, figs 21, 22; 1982b:fig. 18.

*Diogenes custos* var. *planimanus*: Alcock, 1905b:66, pl. 6, fig. 3; Sundara Raj, 1927:133; Kamalaveni, 1950:80; Gordan, 1956:317. ? *Diogenes planimanus*: Ajmal Khan and Natarajan, 1984:16, fig. 13.

**MATERIAL EXAMINED.** Lectotype (herein designated). ♀ (SL = 5.7 mm) Madras; BMNH 1894:7:21:4. Type locality restricted by lectotype designation to Madras.

Lanchester material examined. 3 ♂, 2 ♀ (SL = 4.72–6.36 mm) Patani; UMZC, Nov. 30, 1899.

**DIAGNOSIS.** Shield (Fig. 4) nearly as broad as long; anterior



**Fig. 8** Dactyl of left 3rd pereopod (mesial view), a. *Diogenes goniochirus* Forest, 1956, ♀ SL = 2.15 mm, UMZC Nov. 30, 1899; b. *Diogenes avarus* Heller, 1865, ♂ SL = 1.53 mm, UMZC Nov. 30, 1899; c. *Diogenes planimanus* Henderson, 1893, ♀ SL = 4.85 mm, UMZC Nov. 30, 1899; d. *Diogenes platvoeti* nom. nov., holotype ♂ SL = 4.81 mm ZMA De201.872; e. *Diogenes platvoeti* nom. nov., ♀ SL = 4.67 mm, UMZC Nov. 30, 1899; f. *Diogenes mixtus* Lanchester, 1902, paralectotype ♂ SL = 5.81 mm, UMZC I.10050.

margin denticulate over entire length. Dorsal margin of branchiostegite denticulate anteriorly and with 3 or 4 distinct spines posteriorly. Ocular peduncles approximately 0.80 shield length, moderately slender. Ocular acicles spinose along entire terminal margin. Intercalary rostriform process slightly overreaching tips of acicular spines; with 2–5 spines on lateral margins in distal two-thirds and terminal spine. Antennular and antennal peduncles approximately equal in length, both overreaching ocular peduncles. Antennal acicle weakly produced mesially, not distinctly forked, anterior margin concave and spinulose or spinose.

Left cheliped (Fig. 12a) with upper margin of dactyl armed with row of closely-spaced spinulose tubercles flanked on either side by row of smaller tubercles; palm with 2 rows of moderately small tuberculate spines on upper margin, proximal margin with row of large blunt or spinulose tubercles; outer surfaces of dactyl, palm and fixed finger all with blunt or acute tubercles, strongest in upper half of palm, lower half of palm flattened, lower margin of palm and fixed finger straight; carpus with double row of spines on upper margin, outer face with irregular row of spines, strongest distally; inner faces of palm and carpus tuberculate. Right cheliped with spinulose upper margin of dactyl partially obscured by long setae; upper margin of palm with irregular row of small spines, outer surface granular or weakly tuberculate; carpus with row of strong spines on dorsal margin and row of smaller spines centrally on outer surface. Ambulatory legs with dorsal margins of dactyls each with double row of small spines, mesial faces (Fig. 8c) each with longitudinal row of small spines partially obscured by row of long setae; propodi, carpi and meri each with double or triple rows of spines or spinules on dorsal margins, lateral faces of propodi, carpi and meri spinulose or tuberculate, distal margins of carpi also spinulose.

Males with paired gonopores, female with single right gonopore. Telson (Fig. 9e) without distinct median cleft, but with markedly asymmetrical lobes; terminal and lateral margins each with several strong spines interspersed by small spinules.

**COLOUR.** Ocular peduncles, antennular and antennal peduncles marked with alternating longitudinal stripes of cream and grey or brownish grey. Rostrum and ocular acicles grey with tinge of red; shield with dark grey-brown patches. Chelipeds and ambulatory legs brown with dark brownish-grey patches (after Tirmizi and Siddiqui, 1982a).

**DISTRIBUTION.** Indian Ocean, including Bay of Bengal and northern Arabian Sea; Malaysia; southeast coast of Australia.

**REMARKS.** Only one of the five syntypes is present in the BMNH's collection, *i.e.*, a female, one of four specimens from Madras. The fifth syntype is from Rameswaram. Presumably the remaining syntypes are in the collection of the Indian Museum. Because of the considerable morphological similarities among *D. planimanus*, *D. violaceus* Henderson, 1893, *D. intermedius* De Man, 1892, and *D. custos* (Fabricius, 1798), we are designating the female in the BMNH collection (BMNH 1894:7:21:4) as the lectotype of *D. planimanus*.

Lanchester reported eight specimens of *D. planimanus*, three from 'Loc. —?' from *Murex* shells, and five from Patani from *Natica* shells. The collection now consists of seven specimens: two (one without a shell and one in a *Thais* sp. shell) presumably are those from the unknown locality; five, of which four were still in shells of two species of *Natica*, presumably are those from Patani. The five latter specimens are indeed *D. planimanus*; the other two are not. Of the specimens of *D. planimanus*, only one is complete, although its left second and third pereopods are detached. The left chelipeds are missing on the other four, as are most of the ambulatory legs. Despite

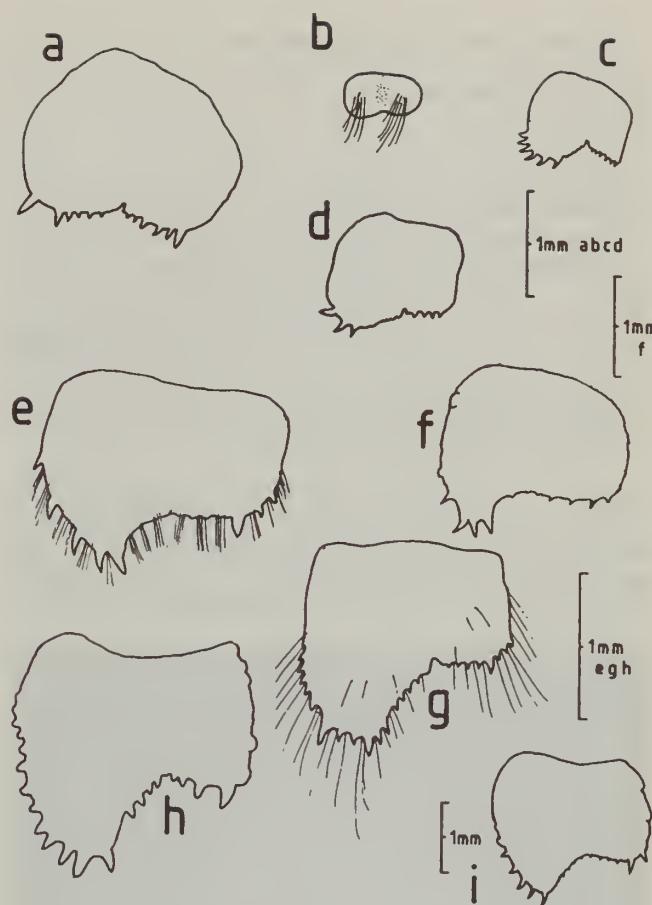


Fig. 9 a. Telson, *Diogenes goniochirus* Forest, 1956, ♀ SL = 2.15 mm, UMZC Nov. 30, 1899; b. anterior lobe of sternite of 3rd pereopod, *Diogenes avarus* Heller, 1865, ♂ SL = 1.53 mm, UMZC Nov. 30, 1899; c. telson, *Diogenes avarus* Heller, 1865, ♂ SL = 1.53 mm, UMZC Nov. 30, 1899; d. telson, *Diogenes avarus* Heller, 1865, ♂ SL = 1.53 mm, UMZC Nov. 30, 1899; e. *Diogenes planimanus* Henderson, 1893, ♀ SL = 4.85 mm, UMZC Nov. 30, 1899; f. telson, *Diogenes platvoeti* nom. nov., holotype ♂ SL = 4.81 mm ZMA De201.872; g. telson, *Diogenes stenops* Morgan and Forest, 1991, ovigerous ♀ SL = 3.11 mm, UMZC Nov. 30, 1899; h. telson, *Diogenes platvoeti* nom. nov., ♀ SL = 4.67 mm, UMZC Nov. 30, 1899; i. *Diogenes mixtus* Lanchester, 1902, lectotype ♂ SL = 6.88 mm, UMZC I.10050.

some variation in the length and armature of the intercalary rostriform process and relative lengths of the ocular, antennular and antennal peduncles these specimens agree well with the lectotype.

Of the two remaining specimens, only one has appendages, although the left cheliped is detached. These specimens are immediately distinguished from *D. planimanus* by the more triangular shape of the shield, longer and more strongly armed intercalary rostriform process, longer antennular peduncles, deeply forked antennal acicles, and ambulatory dactyls that lack a row of spines on the mesial faces.

Dechancé (1964) indicated that *D. planimanus* may have been confounded with *D. custos* over a large portion of the range of the latter. *Diogenes custos*, as described and illustrated by Tirmizi and Siddiqui (1982a), does share some characters with Lanchester's two misidentified specimens, including the longer rostriform process and unarmed mesial faces of the ambulatory dactyls. However, as discussed below, Lanchester's specimens represent *D. intermedius*.

The identity of specimens assigned to *D. planimanus* by Ajmal Khan and Natarajan (1984: 16, fig. 13) is uncertain.

*Diogenes platoventi* nom. nov.

(Figs 5, 6, 8d, e, 9f, h, 12b)

*Diogenes* sp. De Man, 1892:352.

*Diog. intermedius* De Man, 1892:354.

*Diogenes intermedius*: Alcock, 1905:165 (list); Gordan, 1956:317 (list); Rahayu and Forest, 1995:385 (key), 387.

MATERIAL EXAMINED. Holotype by monotypy. ♂ (SL = 4.81 mm), Pare Pare, Celebes (Sudawesi, Indonesia), 1889, coll. M. Weber, ZMA De.201.872; holotype of *D. intermedius* De Man, 1892. Lanchester's material. 1 ♀ (SL = 4.67 mm), 1 ♂ (SL = 5.86 mm) lodged in shell of *Thais* sp., (Malaysia), collection site unknown, 'Skeat' Expedition; UMZC Nov. 30, 1899.

DIAGNOSIS. Shield (Figs 5, 6) slightly longer than broad, roundly triangular; dorsal surface weakly spinulose and rugose; anterior margin very weakly denticulate between obsolete rostrum and produced lateral projections. Dorsal margin of branchiostegite nearly smooth, with sparse row of setae. Ocular peduncles approximately

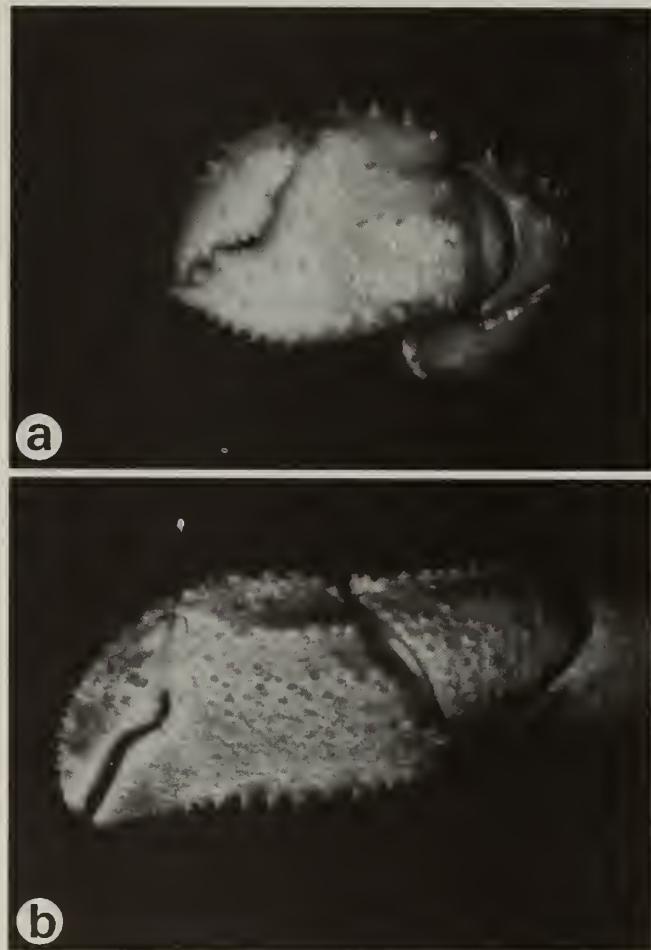


Fig. 10 Left chela (outer face), a. *Diogenes inglei* sp. nov., holotype ovigerous ♀ SL = 1.46 mm, BMNH 1905.10.21.33; b. *Diogenes rectimanus* Miers, 1884, holotype ♂ SL = 4.30 mm, BMNH 1882.7. Left chela (outer face), a. *Diogenes inglei* sp. nov., holotype ovigerous ♀ SL = 1.46 mm, BMNH 1905.10.21.33; b. *Diogenes rectimanus* Miers, 1884, holotype ♂ SL = 4.30 mm, BMNH 1882.7.

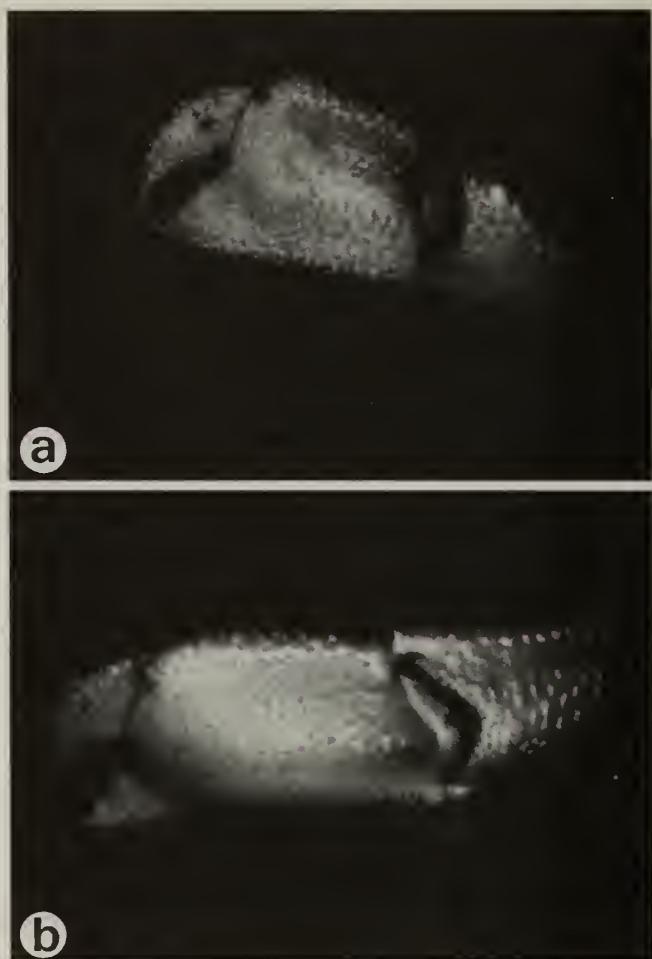


Fig. 11 Left chela (outer face), a. *Diogenes goniochirus* Forest, 1956, ♀ SL = 2.15 mm, UMZC Nov. 30, 1899; b. *Diogenes avarus* Heller, 1865, ♂ SL = 1.53 mm, UMZC Nov. 30, 1899.

0.90 length of shield, moderately slender. Ocular acicles with 3 or 4 spines mesially and marginal row of very tiny spinules. Intercalary rostriform process approximately 0.3 longer than longest acicular spines; with 3–5 prominent spines, 4 or 5 additional much smaller blunt spinules on lateral margins, and blunt or acute terminal spine. Antennular peduncles overreaching antennal peduncles by 0.60–0.75 length of ultimate segment, and ocular peduncles by entire ultimate segment. Antennal acicle strongly bifurcate, outer projection slightly overreaching distal margin of penultimate segment, inner reaching slightly beyond proximal half; anterior margins of both spinose. Antennal flagellum with irregular long and short setae, at least in proximal half.

Left cheliped (Fig. 12b) with upper margin of dactyl armed with double row of closely-spaced small subacute spines, innermost smallest, with intervening row of long setae; palm with double row of larger subacute spines, proximal margin not distinctly delimited; outer surfaces of dactyl, palm and fixed finger with scattered small subacute or acute spines, largest forming faint arch medianly on palm, lower margin of palm and fixed finger convex, with generally double row of subacute spines; carpus with numerous small spines on outer surface, strongest in lower half, upper margin with double row of spines; inner faces of palm and carpus tuberculate. Right cheliped with row of long stiff setae between and practically obscur-

ing double row of small spines on upper margin of dactyl; upper margin of palm with very short double row of small spines, outer surface of palm, fixed finger and dactyl with widely scattered small spines and tufts of long setae; carpus with row of spines on upper margin, and outer face with scattered spinules and longitudinal row of spines, all partially obscured by long setae. Ambulatory legs with dorsal margins of dactyls each with somewhat irregular row of small spines and long stiff setae, lateral surfaces each with longitudinal sulcus, mesial surfaces (Fig. 8d, e) each with 2 longitudinal rows of quite long setae; propodi each with double row of spines on dorsal surface, carpi and meri each with single row of spines; lateral surfaces of propodi and carpi tuberculate or spinulose, lateral faces of meri nearly smooth; segments all with setose lateral surfaces.

Telson (Figs 9f, h) without median cleft, but with incipient lobes markedly asymmetrical; smaller right lobe with few moderately strong spines on terminal margin, lateral margin with several tubercles or protuberances; elongate, subtriangular left lobe with few spines on oblique terminal margin and series of spines on lateral margin.

COLOUR. Unknown.

DISTRIBUTION. Indonesia; Malaysia.

ETYMOLOGY. This species is named for Dirk Platvoet, Curator of Crustacea, the Instituut voor Taxonomische Zoölogie, Zoölogisch Museum, Universiteit van Amsterdam. The authors of this study hope that honour has been fully satisfied and thank Dirk for his persistence in locating the type of *Diogenes intermedius* De Man.

REMARKS. The species name *Diogenes intermedius* of De Man, 1892 is preoccupied by *Diogenes pugillator* var. *intermedius* Bouvier, 1891 (see page 404). According to ICZN 1985: 39, Article 16, a name proposed with the term 'variety' or 'form' before 1961 does not prevent availability [Art. 45g]. The species of De Man (1892) is, therefore, given the replacement name *Diogenes platvoeti* nom. nov.

Of the two specimens in the Lanchester collection, only the female has chelipeds and ambulatory legs. Both the holotype and the Malaysian specimens are notable in lacking armature on the dorsal margins of the branchiostegites. Lanchester's specimens differ from the holotype in having slightly longer antennular and antennal peduncles. In these specimens the antennal peduncles overreach the distal margin of the corneae by nearly the entire length of the ultimate segment (Fig. 6); the antennal peduncles exceed the corneae by 0.25–0.35 the length of the fifth segment. In the holotype, the corneae are exceeded by only 0.75 the length of the ultimate antennular segment (Fig. 6) and 0.15–0.20 the length of the fifth segment of the antennal peduncles. De Man (1892) distinguished *D. intermedius* [now *D. platvoeti* nom. nov.] from *D. custos* by the more strongly bifurcate antennal acicles of his specimen. The acicles of Lanchester's specimens are similarly more strongly forked (Fig. 6), differing from the holotype (Fig. 5) only in having the outer projection slightly broader and the inner projection slightly shorter. The spination of the lateral margins of the second segment of the antennal peduncle is slightly stronger in Lanchester's material, but the dorsal surface is more spinulose in the holotype. Minor differences between the holotype (Fig. 5) and Malaysian specimens (Fig. 6) have also been observed in the intercalary rostriform process, which in the former is longer and more prominently spinulose in the proximal half.

There is general agreement between Lanchester's intact specimen and De Man's specimen as it pertains to armature of the chelipeds; however, we did find a difference in the specific number of spines present on the inner marginal row of the dactyl and on the upper margin of the palm of the left cheliped. Similarly, the spines on the

outer face of the palm are somewhat stronger in the Malaysian specimen than in the holotype. The row of spines on the dorsal margin of each of the ambulatory dactyls is also stronger in Lanchester's specimens, and the median setal row on the mesial face more complete (Figs 8d, e). The telsons of Lanchester's specimens are also more strongly armed, but the general configuration of the lobes is comparable and the median cleft is absent in both (Figs 9f, h). Tirmizi and Siddiqui (1982a) noted that females of *D. custos* have a gonopore only on the right coxa of the third pereopods. Lanchester's female has paired gonopores, a character which distinguishes it not only from *D. custos*, but also *D. planimanus*.

#### *Diogenes stenops* Morgan and Forest, 1991

(Figs 7a, 9g, 13b)

*Diogenes senex*: Lanchester, 1902:366; non *Diogenes senex* Heller, 1865.

*Diogenes jousseaumei*: Morgan, 1987b:179; non *Diogenes jousseaumei* (Bouvier, 1897).

*Diogenes stenops* Morgan and Forest, 1991:671, figs 9, 10.

MATERIAL EXAMINED. Paratypes: 2♂ (SL = 3.20, 5.40 mm), 1♀ (SL = 4.90), 25 mi south of Cairns, Queensland, 8 November 1965, 27 m, WAM 516-65; 1♂ (SL = 2.42 mm), New Year's Island

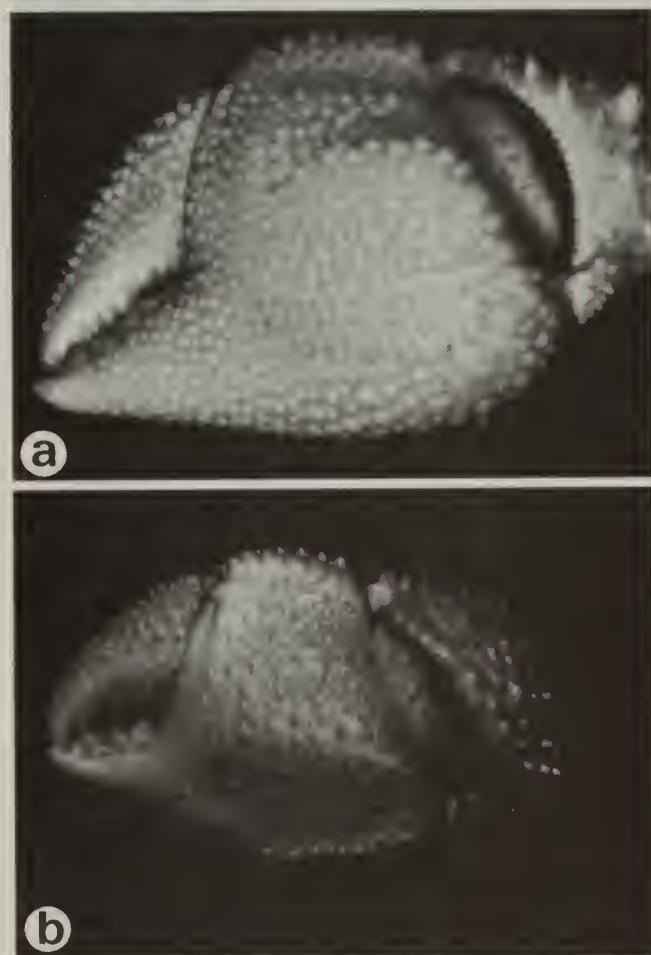
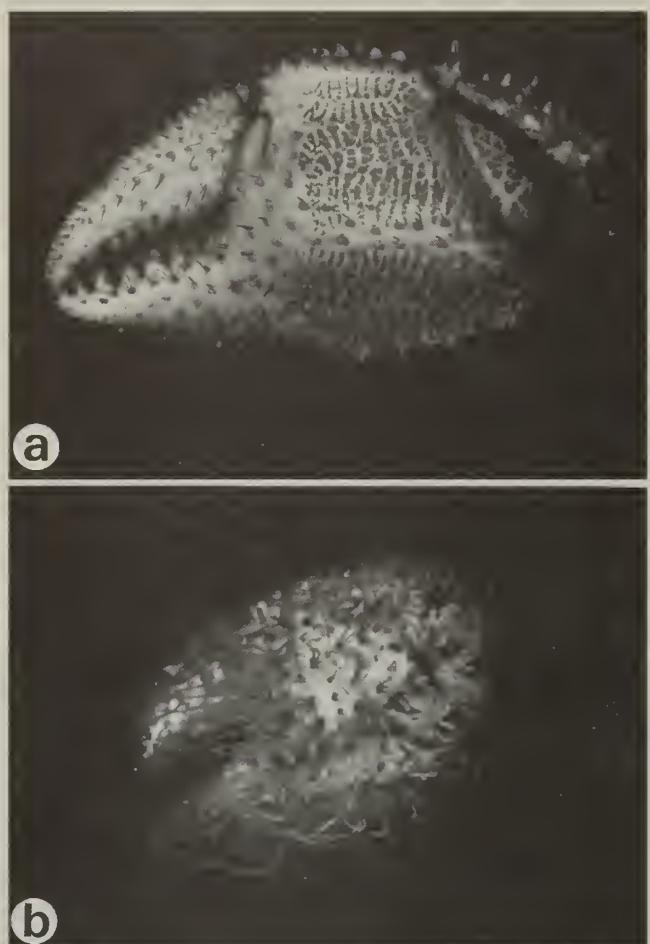


Fig. 12 Left chela (outer face), a. *Diogenes planimanus* Henderson, 1893, ♀ SL = 4.85 mm, UMZC Nov. 30, 1899; b. *Diogenes platvoeti* nom. nov., ♀ SL = 4.67 mm, UMZC Nov. 30, 1899.



**Fig. 13** Left chela (outer face), a. *Diogenes mixtus* Lanchester, 1902, paralectotype ♂ SL = 5.81 mm, UMZC I.10050; b. *Diogenes stenops* Morgan and Forest, 1991, ovigerous ♀ SL = 3.11 mm, UMZC Nov. 30, 1899.

(10° 54', 133° 01'E), October 1962, WAM 403-65. Lanchester collection: 1 ovigerous ♀ (SL = 3.11 mm), Pulau Bidan, Penang; UMZC, Nov. 30, 1899.

**DIAGNOSIS.** Dorsal surface of shield (Fig. 7a) with tubercles and spines, often in short transverse ridges. Ocular peduncles long and slender, slightly overreached by antennular peduncles. Ocular acicles with 3–5 spines on terminal margins. Intercalary rostriform process very small, not reaching half length of ocular acicles. Antennal peduncles slightly overreaching distal margins of corneae. Antennal acicles with terminal spine and 3 or 4 spines on mesial margin. Antennal flagella with long ventral setae.

Left cheliped (Fig. 13b) with dense plumose setae obscuring armature, particularly on dactyl and palm; dactyl and palm with row of strong spines on upper margin; outer faces of fixed finger and palm with scattered tubercles or small spines, lower margins with spines or spinulose tubercles; carpus with row of 6 or 7 very strong spines on upper margin, distal margin with several spines, 1 or 2 very prominent spines on outer surface near distal midline. Right cheliped with row of small spines on upper margin of dactyl; upper margin of palm with strong distal spine and smaller spines or tubercles proximally, outer face with slight to prominent depression on outer face in upper half and scattered spinulose

tubercles on outer surface of palm and fixed finger; carpus with strong spine at upper distal angle; outer face with strong spine on distal margin in upper half, outer surface and upper margin tuberculate or spinulose. Ambulatory legs with scattered long setae on all segments; dactyls and propodi of second and right third unarmed; carpi each with dorsodistal spine; left third slightly shorter than right or second pereopods, ventral margin of propodus with row of spinules; dactyl and propodus with appreciably more dense tufts of setae, carpus with row of spinules or tubercles ventrolaterally and scattered tubercles on lateral surface, obscured by tufts of setae.

Telson (Fig. 9g) with median cleft distinct, but not deep; posterior lobes markedly asymmetrical, terminal margins with several large and numerous smaller spines, extending onto lateral margins, at least on left.

**COLOUR.** Shield cream and pale brown with darker patches. Ocular peduncles cream with some brown dorsally and ventrally; cornea black with iridescent yellow speckling. Antennules and antennae cream. Chelipeds cream and dark brown. Second and third pereopods cream with grey-brown mottling, often with irregular brown band proximally on dactyls and at mid-length of propodi, carpi and meri. Setae pale grey, yellow or brown (after Morgan and Forest, 1991).

**DISTRIBUTION.** Northern Australia from the Northern Territory east to the vicinity of Townsville, Queensland; Penang, Malaysia.

**REMARKS.** Morgan (1987b) reported *Diogenes jousseamei* (Bouvier), a species of the *Troglopagurus* group of *Diogenes* from the Port Essington, Northern Territory, Australia, but after examining syntypic material of Bouvier's (1897) species, concluded that his Australian material represented a very similar, but specifically distinct taxon (Morgan and Forest, 1991). In this latter account, Morgan and Forest commented that the previous record of *D. jousseamei* from Port Curtis, Queensland by Grant and McCulloch (1906) should be regarded with 'some suspicion', and that the records of this species from the Indian region (Alcock, 1905; Southwell, 1906) might require substantiation. Haig and Ball (1988) reported *D. jousseamei* from the Arafura Sea and Torres Strait, and their colour notes do not agree particularly well with those given by Morgan (1987b) and Morgan and Forest (1991) for *D. stenops*, thus it is possible that both species do occur in the region. Although actual specimens were not in their collection, Rahayu and Forest (1995) included *D. jousseamei* in their key to *Diogenes* species in Indonesian waters; *D. stenops* was not mentioned from Indonesia, but in an addendum, these authors reported its occurrence in Singapore.

Lanchester's (1902) *D. senex* from Pulau Bidan, Penang, clearly is not conspecific with Heller's (1865) *D. senex sensu stricto*. The markedly reduced intercalary rostriform process and heavy setation of the cheliped unquestionably place it in the *Troglopagurus* group of *Diogenes*. Despite the absence of the right cheliped, Lanchester's specimen compares very well with the four paratypes of *D. stenops* we have examined. However, in the shape of the shield, Lanchester's specimen agrees better with their illustrated holotype (Morgan and Forest, 1991, fig. 9) in having sloping anterolateral margins on the shield. In all four paratypes, these margins are much straighter, giving the shield a subquadrate appearance. The spination of the left third pereopod of the Lanchester specimen corresponds quite well with the smaller two paratypes. Apparently the spines on the ventral margin of the carpus are reduced with increased animal size, as this margin has only a row of minute, easily overlooked spinules in the larger paratypes. The setation, particularly of the left chela, in Lanchester's specimen appears more coarse than any of the Australian paratypes. In the shape and armature of the antennal acicles,

Lanchester's specimen does more closely resemble Morgan and Forest's (1991: fig. 11b) illustration of the syntype of *D. jousseaumei*; however, it falls well within the range of variation in acicular length and armature seen in *D. stenops*. It is quite possible that *D. stenops* and *D. jousseaumei* may coexist geographically while occupying different microhabitats. With the exception of shell occupancy (*Murex* is reported for *D. stenops*), little is known about the ecology of either species.

Another instance of geographic sympatry in species of the *Troglapagurus* group has recently been documented. As previously indicated, *Diogenes stenops* has been recorded from Singapore (Rahayu and Forest, 1995), the type locality of *D. jubatus* Nobili, 1903. Although rarely reported and poorly known, the recent redescription of *D. jubatus* by Lemaitre and Ng (1996) demonstrates clearly the distinctiveness of the two species.

### *Diogenes mixtus* Lanchester, 1902

(Figs 7f, 8f, 9i, 13a)

*Diogenes mixtus* Lanchester, 1902:367, pl. 34, figs 2, 2a, 2b; Nobili, 1903:16; Alcock, 1905b:165 (list).

MATERIAL EXAMINED. Lectotype (herein selected). ♂ (SL = 6.88 mm), Pulau Bidan, Penang, Malay Peninsula; UMZC I.10050. Paralectotypes. 7♂, 14♀, 1 ovigerous ♀ (SL = 4.15–7.53 mm), Pulau Bidan, Penang, Malay Peninsula; UMZC I.10050.

Additional material. 1♀ (SL = 4.95 mm), Kuching, Malaysia; BMNH 1928.12.1.283.

DIAGNOSIS. Shield (Fig. 7b) with anterior margin weakly denticulate over 0.75 total length; rostrum obtuse, not reaching level of lateral projections. Rostriform process elongate, overreaching ocular acicles by approximately third own length, multidenticulate. Branchiostegites unarmed. Ocular peduncles overreached by both antennular and antennal peduncles; ocular acicles broadly triangular, with 1 or 2 prominent spines mesially, with row of smaller spines extending entire terminal margin. Antennal acicle bifurcate; mesial fork with 0–2 small spines on outer margin and 2–4 smaller spines on inner margin; lateral fork reaching beyond distal margin of fourth peduncular segment, 4 or 5 small spines on inner margin and 0–3 spinules on outer margin.

Left cheliped (Fig. 13a) with outer face of palm armed with double row of blunt spines extending from nearly proximal margin almost to tip of fixed finger, with blunt spines scattered on fixed finger and in somewhat irregular rows on ventral margin, midline of palm with 2 irregular rows and tubercles dorsally; upper margin with 2 rather widely-spaced rows of small spines; dactyl with similar rows of spines; carpus with double row of somewhat blunt spines on upper surface, distal margin of outer face with row of spines curving proximally near ventral margin; merus with acute row of spines on dorsal margin, ventrolateral margin with row of acute spines, ventromesial margin with double row of somewhat blunted spines. Dorsal surface of palm of right cheliped with scattered spines, partially obscured by long setae, dorsomesial margin with row of small spines; upper outer and distal margins of carpus each with irregular row of acute spines. Ambulatory legs generally similar; dactyls (Fig. 8f) longer than propodi, dorsal margins with small spines becoming obsolete in distal half; propodi each with 2 rows of spines on dorsal surface; carpi each with row of spines on dorsal margin.

Telson (Fig. 9i) with terminal margin minutely spinulose on right, strongly spinose on left and approaching lateral angle, continued onto lateral margin over approximately half length.

REDESCRIPTION. Shield (Fig. 7b) longer than broad, subovate to subquadrate; anterior margin with row of closely-spaced small tubercles or blunt spinules over 0.75 to entire width; rostrum obtuse or broadly triangular, weakly produced, not reaching level of lateral projections; lateral projections unarmed or with small to moderately strong terminal blunt or acute spinule. Intercalary rostriform process elongate, overreaching ocular acicles by 0.25–0.50 own length, multidenticulate, with 3–7 lateral spines on each side of terminal simple, bi- or trifid spine. Inner pterygostomial plate (cf. Pilgrim, 1973) with strong distal spine. Branchiostegites with upper margin usually with row of closely-spaced small blunt or spinulose tubercles partially obscured by tufts of long setae.

Ocular peduncles, moderately slender, corneae not particularly dilated; overreached by both antennular and antennal peduncles. Ocular acicles broadly triangular, usually with 1 or 2 more prominent spines mesially, with row of smaller spines or spinulose tubercles extending entire terminal margin.

Antennular peduncles overreaching ocular peduncles by 0.25 to nearly entire length of ultimate segment; overreaching antennal peduncles by 0.10–0.50 length of ultimate segment. Ultimate and penultimate segments with scattered setae. Basal segment with row of tiny spinules or tubercles on both distomesial and distolateral margins.

Antennal peduncles with numerous long setae on fifth segment, particularly dorsally and ventrally. Fourth segment with scattered stiff setae. Third segment with spinule at ventrodistal angle. Second segment with dorsolateral distal angle produced as acute spine, lateral margin with low protuberances or spinules and long setae; dorsomesial margin with row of small spinules, dorsal surface with scattered spinules. First segment with row of tiny tubercles or spinules on dorsal, dorsolateral and ventrolateral distal margins, ventrodistal angle with strong spine. Antennal acicle strongly bifurcate; mesial fork with acute or bifid termination, 0–2 small spines on outer margin and 2–5 smaller spines on inner margin; lateral fork reaching to or beyond distal margin of fourth peduncular segment, terminating in acute simple or bifid spine, 4–14 small spines on inner margin and 0–4 spinules on outer margin, dorsal surface usually with scattered spinules. Antennal flagellum moderately long, usually reaching to or beyond tip of left chela; several proximal articles usually with 1 or 2 short or moderately long stiff setae; setae of articles in distal two-thirds much shorter.

Left cheliped (Fig. 13a) with fingers opening nearly vertically; cusp-like calcareous teeth on cutting edges of both dactyl and fixed finger. Upper margin of dactyl armed with double row of small spines and moderately dense, but relatively short setae; outer surface with scattered small conical tubercles, row of tufts of stiff setae adjacent to cutting edge; inner surface with scattered tufts of setae. Palm with double row of subacute or acute spines on upper margin; outer surface triangularly convex, with widely scattered conical, often rather blunt spines on both lower half of palm and fixed finger, 2 irregular frequently rather widely-separated longitudinal rows of slightly stronger spines in midline of palm and 1 shorter row in upper half, row of blunt or subacute spines on lower margin, becoming double row on fixed finger, lower and inner surfaces of palm tuberculate. Carpus with double row of acute, subacute or blunt spines on upper surface; outer face with numerous spines, strongest in lower half, distal margin with row of small spines, lower margin spinulose or spinose, inner face with weakly tuberculate or spinulose distal margin, longitudinal row of spinulose protuberances or spines and long setae near upper margin. Merus broadly triangular distally; acute row of spines on dorsal margin, diverging distally into mesial, dorsal and lateral rows extending to or nearly to distal margins; dorso- and laterodistal margins with continuous row of moderately

strong, slender spines; ventrolateral margin with row of acute spines, ventromesial margin with irregular double row of subacute or acute spines, ventral surface spinulose or tuberculate. Ischium with spinules or small spines on ventromesial and ventrolateral margins.

Right cheliped with moderately long and slender chela; fingers opening nearly horizontally and terminating in strong calcareous claws. Dorsal surface dactyl with 2 rows of spines and 1 additional row on dorsomesial margin, all partially obscured by long setae. Palm with scattered moderately strong spines, partially obscured by long setae, dorsomesial margin with single or row of small spines, mesial face somewhat spinulose; fixed finger with 2 or 3 rows of small spinules and tufts of long setae on dorsal surface; dorsolateral margin not well defined, but with numerous small spinules. Carpus broadly triangular; dorsomesial margin with row of small spines practically obscured by long dense setae, and adjacent row of stronger spines on dorsal surface, dorsolateral margin with single or irregular double row of spines and tufts of setae, distal margin with several spines; lateral face spinulose; mesial face weakly tuberculate. Merus triangular; dorsal margin with row of spinules or small spines and tufts of long setae, 2 or 3 prominent spines at or near distal margin, often 1 additional strong spine marginally just laterad of midline; dorso- and laterodistal margins usually with small spinules; lateral face frequently with numerous short multifid ridges; ventrolateral margin with row of strong spines or acute spines distally and small, multifid short ridges proximally; ventromesial margin with generally double row of small spinules. Ischium with row of small spines or spinules on ventromesial margin; laterodistal margin with few spinules.

Ambulatory legs generally similar form left to right; dactyls (Fig. 8f) long, approximately 0.20 longer than propodi, slender, curved, slightly twisted; ventral margins each with row of long setae; lateral faces each with longitudinal suture; dorsal margins with small spines becoming obsolete in distal half and long setae; mesial faces each with longitudinal sulcus lined with long setae, row of small spines ventrally decreasing in size and not reaching to distal third and gradually replaced by row of long setae. Propodi each with 2 rows of spines on dorsal surface, strongest mesially and separated by flattened, unarmed or intermittently spined longitudinal space; lateral face with longitudinal row of spinulose tubercles or spines dorsally and usually numerous simple or multidenticulate tubercles, sometimes only weakly developed; ventral surface faintly spinulose, ventrodistal margin usually with row of denticles extending mesially and laterally; mesial face somewhat spinulose ventrally or with irregular longitudinal rows of small tubercles. Carpi each with row of strong spines on dorsal margin; lateral face with 3–5 usually longitudinal rows of spines, spinules, multidenticulate tubercles or low protuberances; laterodistal margin spinose or spinulose; mesial faces each with longitudinal row of small spines adjacent to dorsal margin (second) or unarmed (third). Meri with dorsal surfaces of second pair distally broadened and armed with irregular double or triple rows of small spines or spinulose tubercles, dorsal margin proximally and on third pereopods each with row of spines; ventromesial margins each with nearly double row of spines or spinulose tubercles; row of small spines on ventrolateral margins; lateral faces, particularly of third weakly spinulose or tuberculate. Sternite of third pereopods subrectangular, with tuft of setae on either side laterally. Sternite of fifth pereopods as slender elongate, tuberculate, calcareous rod.

Protopod of right uropod with well developed posterior protuberance nearly equal to size of endopod, and similarly covered with rasp of corneous scales. Telson (Fig. 9i) without median cleft; terminal margin spinulose on right, strongly spinose approaching left lateral angle and continuing onto lateral margin over approximately half length.

COLOUR. Not known.

DISTRIBUTION. Malaysia; ? Singapore.

REMARKS. Nobili (1903) reported numerous specimens of *D. mixtus* collected in Singapore. He distinguished Lanchester's (1902) species from *D. intermedius* De Man, 1892 by the presence, in the former species, of spines on the merus of the second and third pereopods. A check of the collections of the Museo Regionale di Scienze Naturali, Torino, failed to locate Nobili's specimens (Elena Gavetti, pers. comm.); therefore it has not been possible to confirm Nobili's (1903) identification. Although it was not represented in their collection, *D. intermedius* was reported as one of the Indonesian species of *Diogenes* by Rahayu and Forest (1995); no mention was made of *D. mixtus*.

### *Paguristes hians* Henderson, 1888

(Fig. 14)

*Paguristes hians* Henderson, 1888:79, p. 8, fig. 4; Alcock, 1905: 40, pl. 3, fig. 2; Southwell, 1906:216; Estampador, 1937:506; Thompson, 1943:415; Gordan, 1956:322 (in part) (lit.); Edwards and Emberton, 1980:236 (list); Haig and Ball, 1988:173; Hogarth, 1988:1100; Morgan, 1990:21.

*Diogenes despiens* Lanchester, 1902:366, pl. 34, figs 1, 1a; Alcock, 1905:165 (list); Gordan, 1956:317 (lit.).

Non *Paguristes hians*: Grant and McCulloch, 1906:33; McCulloch, 1913:346 = *Paguristes monoporus* Morgan, 1987.

MATERIAL EXAMINED. Holotype. ♂ (SL = 4.89 mm); BMNH 1888.33., H.M.S. 'Challenger' station 208, off Manila. Supplemental material. 1 ♂, 2 ovigerous ♀ (SL = 1.67–2.51 mm), Maldives Islands, 14 February, 20 December 1993, collector P. Hogarth.

DIAGNOSIS. Shield (Fig. 14) considerably longer than broad. Rostrum broadly triangular, not produced to level of terminal spinules of obtusely triangular lateral projections. Ocular peduncles long and extremely tenuous, slightly overreaching antennular peduncles and approximately 0.50 longer than antennal peduncles; acicles elongate and nearly rectangular, with large tuberculate terminal spine and smaller accessory spine laterally. Subquadrate calcified lobe with 4 subacute spinules on anterior marginal part of, or articulating with, interocular lobes. Antennal acicle long, reaching nearly to mid-length of ultimate peduncular segment.



Fig. 14 *Paguristes hians* Henderson, 1888, holotype ♂ SL = 4.89 mm, BMNH 1888.33. a. whole animal; b. enlarged view of shield and cephalic appendages.

Chelipeds (Fig. 14) similar, subequal; dactyls and fixed fingers with distinct hiatus; dorsal surfaces of palms relatively smooth proximally with only few spinules, stronger spines distally; dorsal surfaces of carpi each with irregular row of spinules becoming strong spines at distal margin. Ambulatory legs with dactyls slightly longer than propodi; propodi and carpi of second each with row of spines on dorsal margins, partially obscured by long setae; propodi of third unarmed, carpi each with spine on dorsodistal margin.

Males lacking paired second pleopods; first paired, but consisting of short, broad, uniramous 2-segmented appendages. Telson with posterior lobes nearly symmetrical; terminal margins rounded, armed with 5 or 6 spines.

**REDESCRIPTION.** Shield (Fig. 14) subtriangular, considerably longer than broad, with numerous small spinules, spinulose tubercles and tufts of plumose setae on dorsal surface, particularly laterally. Rostrum broadly triangular, with very small terminal spinule, not produced to level of terminal spinules of obtusely triangular lateral projections. Branchiostegite with 4 or 5 slender acute spines on dorsodistal margin partially to entirely obscured by long setae.

Ocular peduncles long and slender, slightly overreaching antennular peduncles and approximately 0.50 longer than antennal peduncles, dorsomesial surface with row of long setae; corneae small, not dilated. Ocular acicles elongate and nearly rectangular, dorsally flattened, with large tuberculate terminal spine and smaller accessory spine laterally, with several long plumose setae distally. Subquadrate calcified lobe (with 4 subacute spinules anteriorly in holotype) seemingly articulated with interocular lobes.

Antennular peduncles not reaching to bases of corneae; ultimate and penultimate segments unarmed; basal segment with very strong curved spine on dorsolateral distal margin, smaller spine on ventrodistal margin.

Antennal peduncles with supernumerary segmentation; reaching only to about distal third of ocular peduncles; fifth, fourth and third segments each with strong ventrodistal spine and scattered long setae, most abundant laterally; second segment with dorsolateral distal angle produced, terminating in bifid spine, lateral margin with row of long setae, dorsomesial distal angle with strong spine; first segment unarmed but with long setae laterally. Antennal acicle long, reaching nearly to mid-length of ultimate peduncular segment, broad and dorsally flattened, lateral margins each with 2 or 3 strong spines and row of very long plumose setae, mesial margins each also with 2 or 3 strong spines and row of plumose setae sufficiently long to form a setal net above antennules, terminating in bifid spine. Antennal flagellum short, not reaching beyond proximal margins of chelipeds; each article with 1 or 2 long and 1 or 2 short setae.

Chelipeds (Fig. 14) similar, subequal, right slightly larger (at least in males). Dactyls approximately twice length of palms; dorsomesial margins each with row of spines, dorsal and mesial surfaces with fairly closely-spaced tuberculate spines and tufts of long setae; cutting edges each with 1 or 2 large calcareous teeth proximally and row of smaller calcareous teeth in distal 0.66, terminating in corneous claw; dactyls and fixed fingers ventrally curved and with distinct hiatus. Palms shorter than carpi, dorsomesial margins each with row of 2 to 4 strong conical spines, dorsal surface relatively smooth proximally with few spinules or spinulose tubercles, stronger spines distally tending to form 1 or 2 irregular rows, and on weakly delimited lateroproximal margin; fixed finger with dorsolateral margin not clearly delimited, dorsal and lateral faces with closely-spaced spinulose tubercles and spines; cutting edge with row of calcareous teeth, strongest proximally; ventral surface of palm with few scattered tubercles; all surfaces with tufts of long setae. Carpi

trapezoidal in dorsal view; slightly less than 0.50 length of meri; dorsomesial margins each with row of 4 strong conical spines, first 1–3 with very small spinule basally on mesial side, dorsolateral margins each with irregular row of smaller spines, dorsal surface with irregular row of spinules becoming strong spines at distal margin; ventrolateral distal margins each with 1 or 2 small tubercles; surfaces with long setae. Meri each with longitudinal row of spinules on dorsal margin in proximal 0.65, distally 1 transverse row of prominent spines extending onto lateral and mesial faces dorsally and second similar row on distal margin; ventromesial margin with row of acute spines; ventrolateral margin with row of small spines in distal half and short transverse rows of spinules proximally. Ischia each with row of spinules on ventromesial margin and 1 small spine at ventrolateral distal angle.

Ambulatory legs with dactyls slightly longer than propodi; in dorsal view slightly twisted, in lateral view curved ventrally in distal halves; all surfaces, and particularly dorsal and ventral margins, with rows of long setae. Propodi of second each with row of spines on dorsal margins; carpi with single or double row of spines, all partially to completely obscured by long setae; propodi of third (left third broken at distal margin of ischium in holotype) unarmed but with tufts of long setae on all surfaces, carpi only with spine at dorsodistal margin or with 2 or 3 small spines in distal half, all at least partially obscured by tufts of long setae. Meri of second each with row of very small spinules and tufts of long setae on dorsal margins, ventral margins each with row of spines and tufts of long setae; third with few minute spinules on dorsal margin and tufts of long setae, ventral margin with tufts of long setae. Ischia each with 1 or 2 spinules on dorsal margins, ventral margins each with row of long setae and 1 small spine near distal margin.

Males with paired gonopores; no paired second pleopods; first paired but consisting of short, broad, uniramous 2-segmented appendages positioned directly over coxae of fifth pereopods; unpaired left pleopods 3 to 5 uniramous. Females with single left gonopore; paired first pleopods modified as gonopods; very large brood pouch. Telson with prominent, deep transverse suture; posterior lobes nearly symmetrical, terminal margins rounded, each armed with 4 to 6 spines, some corneous-tipped, and few moderately long setae.

**COLOUR.** Not reported.

**DISTRIBUTION.** Oman; Maldives; Red and Arabian Seas; Malaysia; Philippines.

**REMARKS.** Henderson (1888) described the species from a single male; however, he made no comment on any of the abdominal appendages. Although *Paguristes hians* is a very distinctive species that possesses characters unique among species of *Paguristes*, only the remarks by Haig and Ball (1988) called attention to any of these. These authors appear to have been the first to document that males lacked the paired second pleopods typical of species of *Paguristes*; they also pointed out the presence of a single left gonopore in the female. It may be that these abnormalities were recognized by Grant and McCulloch (1906) and McCulloch (1913) who incorrectly identified atypical *Paguristes* specimens from Mast Head Island, Queensland, Australia, as *P. hians*. Haig (in Haig and Ball, 1988) showed that at least some of the Mast Head Island specimens actually were referable to *P. monoporus* Morgan. As described by Morgan (1987a) this is another rather bizarre species of *Paguristes* in which male first and second pleopods are reduced and restricted to the right side of the abdomen; males possess only a single right gonopore and females have only a single left.

While the characters described above for *P. hians* set this species

apart from all other known *Paguristes* species, they are not the characters that drew our attention to the similarities between this species and Lanchester's (1902) *Diogenes desipiens*. *Paguristes hians* has uniramous unpaired male pleopods, a character commonly associated with species of *Diogenes*. Similarly, *P. hians* has a subquadrate calcified lobe that is, at least positionally, similar to the intercalary rostriform process that distinguishes most *Diogenes* species from other Diogenidae. In the holotype of *P. hians* this structure is armed with 4 marginal spinules. In the three small specimens from the Maldives Islands, this process appears almost identical to that of *D. desipiens* as shown by Lanchester (1902: fig. 1); in one specimen, it appears denticulate under high magnification, as described for *D. desipiens*. Additionally, the distinctive shape, armature, and setation of the ocular and antennal acicles of *P. hians* are virtually identical to those described and illustrated by Lanchester for *D. desipiens*. Lanchester's description of the shield armature, as well as ocular peduncle length and its relationship to the lengths of both the antennular and antennal peduncles agrees extremely well with those of *P. hians*. Furthermore, Lanchester described the chelipeds of his species as being subequal, the right being slightly larger. We know of no *Diogenes* species in which the chelipeds are subequal, but *P. hians* has subequal chelipeds, the right of which is slightly larger in the holotype and male specimen from the Maldives Islands. Lanchester's description of the armature of the chelipeds also agrees quite closely with the type of *P. hians* and the three smaller specimens that we examined. Similarly there is agreement between the length ratios of the dactyls and propodi of the ambulatory legs of the two species. However, disagreement between Lanchester's description of *D. desipiens* and our observations of *P. hians* is found in the armature of these appendages. We observed that the ventral margins of the dactyls of the holotype have a row of slight protuberances; the Maldives Islands specimens each have a row of corneous spinules on these margins. The dorsal margins of the propodi and carpi of the second pereopods each carries a row of spines, and the carpi of the third may have from 1 to 3 spines on the dorsal margins in our specimens. The dorsal margins of the meri of both pairs of pereopods are armed with spines; the ventral margins of the second pereopods also are spinose. But all of the spines are at least partially obscured by tufts of setae. Lanchester described the ambulatory legs as being 'densely hairy on their upper and lower margins, otherwise smooth.' Whether Lanchester simply failed to notice spines amongst the setal tufts on his specimen, or they were actually lacking, is a matter of speculation. Given all of the other similarities between the two taxa, we are inclined to presume the former. Therefore, until specimens having all of the attributes accredited to Lanchester's taxon are found in a species unquestionably referable to *Diogenes*, we consider *D. desipiens* a junior subjective synonym of *Paguristes hians*.

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